Laser ablation dynamics and production of thin films of lysozyme

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Lysozyme is a well-known protein, which is used in food processing because of its bacteriocidal properties. The mass (14307 u) is in the range, in which it easily can be controlled by mass spectrometric methods, for example by MALDI (Matrix assisted laser desorption ionisation). We have recently at the Technical University of Denmark (DTU) produced thin films of average thickness up to 300 nm, which not only contained a significant amount of intact molecules, but also maintained the bioactivity. These films were produced by a nanosecond laser in the UV regime at 355 nm with 2 J/cm^2. The surprising fact that these molecules can be transferred to a substrate as intact molecules by the violent laser impact (~up to 50 mJ/pulse) has not yet been understood. One issue is that up to 150 ng/pulse is removed by the laser, and much of the material is ejected from the target in relatively large chunks.
We have continued these experiments at CNR-SPIN, Napoli, to explore the excitation mechanics by laser impact. Samples of pressed lysozyme prepared in the same manner as in DTU have been irradiated at 523 nm with 300-fs pulses and a fluence of the same order of magnitude as in DYU. Even though the pulse energy was much smaller, there was a considerable ablation weight loss of lysozyme from each shot. This is the first time the ablation by fs-lasers of a protein has been recorded quantitatively. Films of lysozyme produced by fs-laser irradiation will be analysed by MALDI in order to explore if there also is a significant amount of intact molecules in the films for fs-laser deposition.